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Patent Department
Mitsubishi Electric Research Laboratories, Inc.
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Cambridge, MA 02139

EXAMINER

PRENDERGAST, ROBERTA D

ART UNIT

PAPER NUMBER

2671

DATE MAILED: 10/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/624,018

Applicant(s)

WURMLIN ET AL.

Examiner

Roberta Prendergast

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>7/21/2003</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: Fig. 1 (element 10, disclosed as element 104 in Specification), Fig. 3 (element 300), Fig. 4 (element 400). Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the examiner does not accept the changes, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 7-8, 10 and 13-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matusik et al., "Polyhedral Visual Hulls for Real-Time Rendering",

Proceedings of Twelfth Eurographics Workshop on Rendering, 2001, pages 115-125, in view of Deering U.S. Patent No. 5867167.

Referring to claim 1, Matusik et al. teaches a method for providing a virtual reality environment, comprising: acquiring concurrently, with a plurality of cameras, a plurality of sequences of input images of a 3D object, each camera having a different pose (page 115, Section 1 Introduction, 4th paragraph; page 123, Section 4 Real-Time System, 1st paragraph); reducing the plurality of sequences of images to a differential stream (page 123, Section 4 Real-Time System, 1st paragraph); rendering the 3D model as a sequence of output image of the 3D object from an arbitrary point of view while acquiring and reducing the plurality of sequences of images and maintaining the 3D model in real-time (page 124, Section 4 Real-Time System, 1st paragraph) but does not specifically teach reducing the plurality of sequences of images to a differential stream of 3D operators and operands and maintaining a 3D model of point samples representing the 3D object from the differential stream, in which each point sample of the 3D model has 3D coordinates and intensity information.

Deering teaches reducing the plurality of sequences of images to a differential stream of 3D operators and operands (Figs. 4 (A-K), 9 (elements 410-450) and 14 (A-J); column 12, lines 35-41; column 17, lines 35-42, i.e. normal, position, and color information for the plurality of images are compressed into a differential stream of 3D operators and operands) and maintaining a 3D model of point samples representing the 3D object from the differential stream, in which each point sample of the 3D model has 3D coordinates and intensity information (Fig. 14B; column 8, lines 18-20; column 9,

lines 50-53, i.e. position information contains the 3D x, y, and z coordinates and normal information indicates intensity information).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include reducing the plurality of sequences of images to a differential stream of 3D operators and operands and maintaining a 3D model of point samples representing the 3D object from the differential stream, in which each point sample of the 3D model has 3D coordinates and intensity information thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65).

Referring to claim 2, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which the acquiring and reducing are performed at a first node, and the rendering and maintaining are performed at a second node, and further comprising: transmitting the differential stream from the first node to the second node by a network (page 123, Section 4 Real-Time System, 1st paragraph).

Referring to claim 3, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, wherein the object is moving with respect to the plurality of cameras (page 115, Section 1 Introduction, 2nd and 4th paragraphs; page 116, Section 1.1 Previous Work, 6th paragraph; page 123, Section 4 Real-Time System, 1st paragraph, i.e. it is understood that the use of four calibrated

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video cameras capturing a video stream and performing processing steps on the video stream indicates movement of the foreground object).

Referring to claim 4, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, wherein the reducing further comprises: segmenting the object from a background portion in a scene; and discarding the background portion (page 123, Section 4 Real-Time System, 1st paragraph).

Referring to claim 7, the rationale for claims 1 and 6 is incorporated herein, Matusik et al., as modified by Deering above, teaches the method of claim 1, comprising reducing the sequences of images to a differential stream having operators but does not specifically teach wherein the operators include insert, delete, and update operators.

Deering teaches wherein the operators include update and insert operators (column 13, lines 19-54; columns 20-21, lines 50-14; column 21, lines 17-29; column 22, lines 6-14 and 42-25; column 23, lines 29-60, i.e. normal and color values are updated by replacing the previous values stored in the mesh buffer with new values labeled as current values, Deering further teaches that other instruction sets may be used and that new vertices may be inserted into the mesh buffer).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the operators include update and insert operators thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65) and thus improving effective bandwidth for a graphics accelerator

system, including shared virtual reality display environments (Deering column 17, lines 7-13).

Further, although Deering does not specifically teach wherein the operators include delete operators said operators are well known in the art, therefore it would have been obvious to one skilled in the art at the time of the invention to include said operators in the method of Matusik et al., because it would provide a more accurate rendering of the image.

Referring to claim 8, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach wherein the associated operand includes a 3D position and color as attributes of the corresponding point sample.

Deering teaches wherein the associated operand includes a 3D position and color as attributes of the corresponding point sample (Figs. 4K, 10 (element 630) and 14 (A-B)).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the associated operand includes a 3D position and color as attributes of the corresponding point sample thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65) and thus improving effective bandwidth for a graphics accelerator system, including shared virtual reality display environments (Deering column 17, lines 7-13).

Referring to claim 10, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which the point samples are maintained on a per camera basis (page 121, Section 3 View-Dependent Texturing, 2nd-4th paragraphs, i.e. sparse point sampling each image by sampling along the 3D rays and forming a texture matrix associated with camera *i* is understood to be maintaining the point samples on a per camera basis).

Referring to claim 13, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which the point samples are rendered as polygons (pages 121-122, Section 3 View-Dependent texturing, 3rd paragraph).

Referring to claim 14, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, further comprising sending a silhouette image corresponding to a contour of the 3D object in the differential stream for each reduced image (page 123, Section 4 Real-Time System, 1st paragraph).

Referring to claim 15, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which the differential stream is compressed (page 123, Section 4 Real-Time System, 1st paragraph).

Referring to claim 16, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach wherein the associated operand includes a normal of the corresponding point sample.

Deering teaches wherein the associated operand includes a normal of the corresponding point sample (Figs. 4K, 10 (element 630) and 14 (A-B)).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the associated operand includes a normal of the corresponding point sample thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65) and thus improving effective bandwidth for a graphics accelerator system, including shared virtual reality display environments (Deering column 17, lines 7-13).

Referring to claim 17, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which the associated operand includes reflectance properties of the corresponding point sample.

Deering teaches wherein the associated operand includes reflectance properties of the corresponding point sample (column 8, lines 49-54).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the associated operand includes reflectance properties of the corresponding point sample thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65) and thus improving effective bandwidth for a graphics accelerator system, including shared virtual reality display environments (Deering column 17, lines 7-13).

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Referring to claim 18, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, in which pixels of each image are classified as either foreground or background pixels, and in which only foreground pixels are reduced to the differential stream (page 123, Section 4 Real-Time System, 1st paragraph).

Claims 9, 12, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matusik et al., "Polyhedral Visual Hulls for Real-Time Rendering", Proceedings of Twelfth Eurographics Workshop on Rendering, 2001, pages 115-125, in view of Deering U.S. Patent No. 5867167 as applied to claim 1 above, and further in view of Pauly et al., "Spectral Processing of Point-Sampled Geometry", *Proc. of 28th Annual Conf. on Computer Graphics and Interactive Techniques*, SIGGRAPH 2001, ACM Press, New York, NY, 379-386.

Referring to claim 9, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach wherein the point samples are rendered with point splatting.

Pauly et al. teaches wherein the point samples are rendered with point splatting (page 382, Section 3 Scattered Data Approximation, Regular Sampling, 2nd paragraph; page 384, Section 7 reconstruction, Blending function).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the point samples are rendered with point splatting thereby allowing for direct

processing or manipulation of point-sampled geometry without a need for polygonal meshes (page 379, Section 1 Introduction, 1st paragraph).

Referring to claim 12, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach estimating a local density for each point sample.

Pauly et al. teaches estimating a local density for each point sample (page 379, Section 1 Introduction, 3rd paragraph).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include estimating a local density for each point sample thereby reducing the complexity of overly dense sample models (page 379, Section 1 Introduction, 3rd paragraph).

Referring to claim 19, the rationale for claims 1 and 8 is incorporated herein, Matusik et al., as modified above, teaches the method of claims 1 and 8 wherein attributes are assigned to each point sample, but does not specifically teach wherein the attributes are altered while rendering.

Pauly et al. teaches wherein the attributes are altered while rendering (page 384, Section 7 Reconstruction, Blending Normals).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the attributes are altered while rendering thereby allowing for direct processing or manipulation of point-sampled geometry without a need for polygonal meshes (page 379, Section 1 Introduction, 1st paragraph).

Referring to claim 20, the rationale for claim 19 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 19, but does not specifically teach wherein the point attributes are organized in a vertex array that is transferred to a graphics memory during the rendering.

Deering teaches wherein the point attributes are organized in a vertex array that is transferred to a graphics memory during the rendering (column 6, lines 35-41; column 7, lines 39-55, i.e. it is understood that the compressed geometry containing the point color and normal attributes is stored in a vertex array in the mesh buffer).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the point attributes are organized in a vertex array that is transferred to a graphics memory during the rendering thereby providing a method for compressing data in real-time that substantially reduces the bit-size of the file to be transmitted with little loss in displayed object quality at low cost (Deering column 5, lines 18-24 and 55-65) and thus improving effective bandwidth for a graphics accelerator system, including shared virtual reality display environments (Deering column 17, lines 7-13).

Claims 5 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matusik et al., "Polyhedral Visual Hulls for Real-Time Rendering", Proceedings of Twelfth Eurographics Workshop on Rendering, 2001, pages 115-125, in view of Deering U.S. Patent No. 5867167 as applied to claim 1 above, and further in view of Kanade et

al. "Virtualized Reality: Constructing Virtual Worlds from Real Scenes", IEEE Computer Society, pp.34-47, January - March 1997.

Referring to claim 5, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not teach wherein the reducing further comprises selecting, at any one time, a set of active cameras from the plurality of cameras.

Kanade et al. teaches wherein the reducing further comprises selecting, at any one time, a set of active cameras from the plurality of cameras (page 37, Section Camera Clusters, i.e. it is understood that the reference camera and 3-6 immediate neighbor cameras are the active cameras).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include a plurality of cameras wherein the reducing further comprises selecting, at any one time, a set of active cameras from the plurality of cameras because using many cameras improves the extent and accuracy of stereo while selecting a set of active cameras from the plurality of cameras reduces the computational costs.

Referring to claim 11, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach wherein the rendering combines the sequence of output images with a virtual scene.

Kanade et al. teaches wherein the rendering combines the sequence of output images with a virtual scene (page 45, Combining virtual and virtualized environments).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the rendering combines the sequence of output images with a virtual scene thereby allowing virtual foreground objects to be introduced into the virtualized environment.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Matusik et al., "Polyhedral Visual Hulls for Real-Time Rendering", Proceedings of Twelfth Eurographics Workshop on Rendering, 2001, pages 115-125, in view of Deering U.S. Patent No. 5867167 as applied to claim 1 above, and further in view of Lee et al. U.S. Patent No. 5684887.

Referring to claim 6, the rationale for claim 1 is incorporated herein, Matusik et al., as modified above, teaches the method of claim 1, but does not specifically teach wherein the differential stream of 3D operators and associated operands reflect changes in the plurality of sequences of images.

Lee et al. teaches wherein the differential stream of 3D operators and associated operands reflect changes in the plurality of sequences of images (column 9, lines 40-67; column 10, lines 26-36).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Matusik et al. to include wherein the differential stream of 3D operators and associated operands reflect changes in the plurality of sequences of images thereby providing a method wherein a

slowly changing background can be updated every frame and the object boundary can be recovered instantaneously by a difference operation (Lee et al. column 10, lines 1-3).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respect to operands and operators/opcodes.

Deering U.S. Patent No. 5793371

Moorer U.S. Patent No. 5867167

Deering U.S. Patent No. 5842004

Karol et al. U.S. Patent No. 6122275

Deering U.S. Patent No. 6459429

The following patents are cited to further show the state of the art with respect to difference frames/images, client-server nodes, data compression, and data transmission.

Cohen-Or U.S. Patent No. 6307567

Mann et al. U.S. Patent No. 6330281

Kelly U.S. Patent No. 2003/0219163

The following patents are cited to further show the state of the art with respect to background subtraction and composition of object and scene images.

Lippman et al. U.S. Patent No. 5262856

Miller et al. U.S. Patent No. 5999641

Deering U.S. Patent No. 5867167

Kanade et al. U.S. Patent No. 6084979

Matsumoto et al. U.S. Patent No. 6356272

Bordeset al. U.S. Patent No. 6909747

The following non-patent literature cited to further show the state of the art.


Gross et al., "Blue-c: a Spatially Immersive Display and 3D Video Portal for Telepresence", *ACM Trans. Graph.* 22, 3 (Jul. 2003), pages 819-827.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Roberta Prendergast whose telephone number is (571) 272-7647. The examiner can normally be reached on M-F 7:00-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

RP


ULKA J. CHAUHAN
PRIMARY EXAMINER